

CLAIMS

1. A spectrometer comprising:
 - at least one slit element located at an object plane;
 - a first optical sub-system having at least one refractive optical element;
 - said first optical sub-system being capable of substantially collimating, at a center plane, electromagnetic radiation emanating from said at least one slit element;
 - at least one dispersive element located substantially at the center plane;
 - a second optical sub-system having at least one refractive optical element;
 - said second optical sub-system and said first optical sub-system being designed substantially according to a symmetrical principle, the center plane being the plane of symmetry;
 - said second optical sub-system being capable of imaging the substantially collimated electromagnetic radiation from the center plane onto an image plane; and,
 - at least one detecting element located substantially at the image plane.
2. The spectrometer of claim 1 wherein said at least one dispersive element comprises a reflective dispersive element; and,
 - said first optical sub-system is also the second optical sub-system, acting as a dual pass optical sub-system.
3. The spectrometer of claim 2 wherein said at least one reflective dispersive element comprises a diffraction grating.
4. The spectrometer of claim 2 wherein said at least one slit element is substantially centered on an optical

axis; and,
said at least one detecting element is centered away from
the optical axis.

5. The spectrometer of claim 2 wherein said at least one
detecting element is substantially centered on an optical
axis; and,
said at least one slit element is displaced from the
optical axis.
6. The spectrometer of claim 1 wherein said at least one
dispersive element comprises a transmissive dispersive
element.
7. The spectrometer of claim 1 wherein said at least one
dispersive element comprises a transmissive diffraction
grating.
8. The spectrometer of claim 1 wherein said at least one
dispersive element comprises a volume transmission
grating.
9. The spectrometer of claim 1 wherein said at least one
dispersive element comprises a volume holographic
transmission grating.
10. The spectrometer of claim 1 wherein said at least one
dispersive element comprises two dispersive elements.
11. The spectrometer of claim 1 wherein said at least one
detecting element comprises two detecting elements.
12. The spectrometer of claim 10 wherein said at least one
detecting element comprises two detecting elements.

13. The spectrometer of claim 1 wherein said at least one slit element comprises two slit elements; each one of said two slit elements being displaced from an optical axis.
14. The spectrometer of claim 13 wherein one of said two slit elements is displaced from the optical axis in an opposite direction, with respect to the optical axis, from another one of said two slit elements.
15. The spectrometer of claim 1 wherein said at least one slit element is displaced from an optical axis.
16. The spectrometer of claim 1 wherein said at least one slit element is substantially centered at an optical axis.
17. The spectrometer of claim 1 wherein said second optical sub-system is substantially symmetric to said first optical sub-system.
18. The spectrometer of claim 1 wherein said second optical sub-system is not substantially symmetric to said first optical sub-system.
19. A spectrometer comprising:
 - at least one slit element located at an object plane;
 - a first optical sub-system having at least one refractive optical element;
 - said first optical sub-system being capable of substantially collimating, at a center plane, electromagnetic radiation emanating from said at least one slit element;
 - at least one dispersive element located at substantially the center plane;
 - a second optical sub-system having at least one

refractive optical element;
said second optical sub-system and said first optical sub-system comprising a substantially symmetrical relay system, the center plane being the plane of symmetry;
said second optical sub-system being capable of imaging the substantially collimated electromagnetic radiation from the center plane onto an image plane; and,
at least one detecting element located substantially at the image plane.

20. The spectrometer of claim 19 wherein said at least one dispersive element comprises a reflective dispersive element; and,
said first optical sub-system is also the second optical sub-system, acting as a dual pass optical sub-system.
21. The spectrometer of claim 20 wherein said at least one reflective dispersive element comprises a diffraction grating.
22. The spectrometer of claim 20 wherein said at least one slit element is substantially centered on an optical axis; and,
said at least one detecting element is centered away from the optical axis.
23. The spectrometer of claim 20 wherein said at least one detecting element is substantially centered on an optical axis; and,
said at least one slit element is displaced from the optical axis.
24. The spectrometer of claim 19 wherein said at least one dispersive element comprises a transmissive dispersive element.

25. The spectrometer of claim 19 wherein said at least one dispersive element comprises a transmissive diffraction grating.
26. The spectrometer of claim 19 wherein said at least one dispersive element comprises a volume transmission grating.
27. The spectrometer of claim 19 wherein said at least one dispersive element comprises a volume holographic transmission grating.
28. The spectrometer of claim 19 wherein said at least one dispersive element comprises two dispersive elements.
29. The spectrometer of claim 19 wherein said at least one detecting element comprises two detecting elements.
30. The spectrometer of claim 28 wherein said at least one detecting element comprises two detecting elements.
31. The spectrometer of claim 19 wherein said at least one slit element comprises two slit elements; each one of said two slit elements being displaced from an optical axis.
32. The spectrometer of claim 31 wherein one of said two slit elements is displaced from the optical axis in an opposite direction, with respect to the optical axis, from another one of said two slit elements.
33. The spectrometer of claim 19 wherein said at least one slit element is displaced from an optical axis.

34. The spectrometer of claim 19 wherein said at least one slit element is substantially centered at an optical axis.
35. The spectrometer of claim 19 wherein said second optical sub-system is substantially symmetric to said first optical sub-system.
36. The spectrometer of claim 19 wherein said second optical sub-system is not substantially symmetric to said first optical sub-system.
37. A method for detecting wavelength dependent content of electromagnetic radiation, the method comprising the steps of:
extracting at least one line source of electromagnetic radiation from a source of electromagnetic radiation;
substantially collimating the electromagnetic radiation emanating from the at least one line source;
angularly separating the substantially collimated electromagnetic radiation according to its wavelength;
imaging the angularly separated electromagnetic radiation onto at least one detecting element;
minimizing transverse aberrations while substantially collimating the electromagnetic radiation emanating from the at least one line source and imaging the angularly separated electromagnetic radiation; and,
detecting the angularly separated electromagnetic radiation.
38. A spectrometer comprising:
means for extracting at least one line source of electromagnetic radiation from a source of electromagnetic radiation;

means for substantially collimating the electromagnetic radiation emanating from the at least one line source;

means for angularly separating the substantially collimated electromagnetic radiation according to its wavelength;

at least one detecting element;

means for imaging the angularly separated electromagnetic radiation onto at least one detecting element; and,

means for minimizing transverse aberrations while substantially collimating the electromagnetic radiation emanating from the at least one line source and imaging the angularly separated electromagnetic radiation.

39. The spectrometer of claim 38 wherein said second optical sub-system is substantially symmetric to said first optical sub-system.
40. The spectrometer of claim 38 wherein said second optical sub-system is not substantially symmetric to said first optical sub-system.
41. The spectrometer of claim 38 wherein said at least one dispersive element comprises a reflective dispersive element; and,
said means for substantially collimating are also said means for imaging, acting as dual means.
42. The spectrometer of claim 11 wherein said at least one dispersive element transmits an undispersed portion of the substantially collimated electromagnetic radiation.
43. The spectrometer of claim 42 wherein said second optical sub-system also images the undispersed portion of

the substantially collimated electromagnetic radiation onto one of said two detecting elements.

44. The spectrometer of claim 29 wherein said at least one dispersive element transmits an undispersed portion of the substantially collimated electromagnetic radiation.
45. The spectrometer of claim 44 wherein said second optical sub-system also images the undispersed portion of the substantially collimated electromagnetic radiation onto one of said two detecting elements.